

# DATA SHEET



## NPN SILICON RF TRANSISTOR

# NE462M02 / 2SC5338 JEITA Part No.

### NPN SILICON RF TRANSISTOR FOR HIGH-FREQUENCY LOW DISTORTION AMPLIFIER 4-PIN POWER MINIMOLD

#### FEATURES

- High gain:  $|S_{21e}|^2 = 10$  dB TYP. @  $V_{CE} = 5$  V,  $I_c = 50$  mA,  $f = 1$  GHz
- Low distortion, low voltage:  $IM_2 = -55$  dB TYP.,  $IM_3 = -76$  dB TYP. @  $V_{CE} = 5$  V,  $I_c = 50$  mA,  $V_{in} = 105$  dB $\mu$ V/75 $\Omega$
- 4-pin power minimold package with improved gain from the NE46234 / 2SC4703

#### ★ ORDERING INFORMATION

Part Number	Quantity	Supplying Form
NE462M02-AZ 2SC5338-AZ	25 pcs (Non reel)	• Magazine case
NE462M02-T1-AZ 2SC5338-T1-AZ	1 kpcs/reel	• 12 mm wide embossed taping • Collector face the perforation side of the tape

**Remark** To order evaluation samples, please contact your nearby sales office.  
Unit sample quantity is 25 pcs.

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = +25^\circ\text{C}$ )

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	$V_{CBO}$	25	V
Collector to Emitter Voltage	$V_{CEO}$	12	V
Emitter to Base Voltage	$V_{EBO}$	2.5	V
Collector Current	$I_c$	150	mA
Total Power Dissipation	$P_{tot}$ <small>Note</small>	1.8	W
Junction Temperature	$T_j$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-65 to +150	$^\circ\text{C}$

**Note** Mounted on  $16\text{ cm}^2 \times 0.7$  mm (t) ceramic substrate (Copper plating)

**Because this product uses high-frequency technology, avoid excessive static electricity, etc.**

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C)**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit	
<b>DC Characteristics</b>							
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0 mA	–	–	1.5	μA	
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>BE</sub> = 2 V, I <sub>C</sub> = 0 mA	–	–	1.5	μA	
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 50 mA	50	–	250	–	
<b>RF Characteristics</b>							
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 50 mA	–	6.0	–	GHz	
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 50 mA, f = 1 GHz	8.5	10	–	dB	
Noise Figure	NF	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 50 mA, f = 1 GHz	–	–	3.5	dB	
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0 mA, f = 1 MHz	–	1.0	2.0	pF	
2nd Order Intermodulation Distortion	IM <sub>2</sub>	I <sub>C</sub> = 50 mA, V <sub>in</sub> = 105 dBμV/75 Ω, f = 190 – 90 MHz	V <sub>CE</sub> = 5 V	–	–55	–	dB
			V <sub>CE</sub> = 10 V	–	–63	–	
3rd Order Intermodulation Distortion	IM <sub>3</sub>	I <sub>C</sub> = 50 mA, V <sub>in</sub> = 105 dBμV/75 Ω, f = 2 × 190 – 200 MHz	V <sub>CE</sub> = 5 V	–	–76	–	dB
			V <sub>CE</sub> = 10 V	–	–83	–	

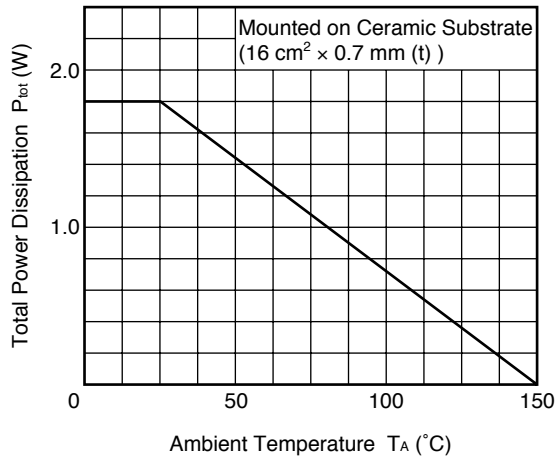
- Notes 1.** Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%  
**2.** Collector to base capacitance when the emitter grounded

**h<sub>FE</sub> CLASSIFICATION**

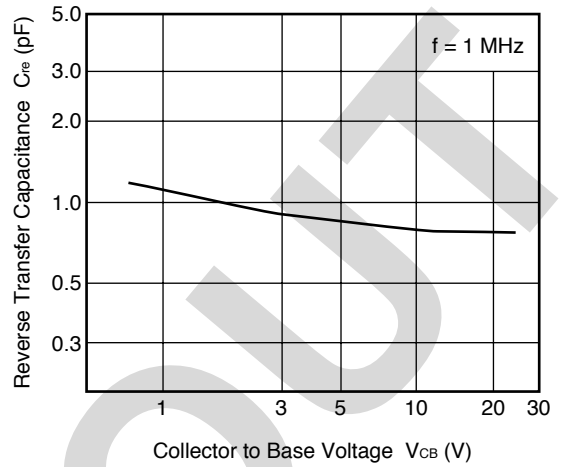
Rank	SH	SF	SE
Marking	SH	SF	SE
h <sub>FE</sub> Value	50 to 100	80 to 160	125 to 250

★ TYPICAL CHARACTERISTICS (Unless otherwise specified,  $T_A = +25^\circ\text{C}$ )

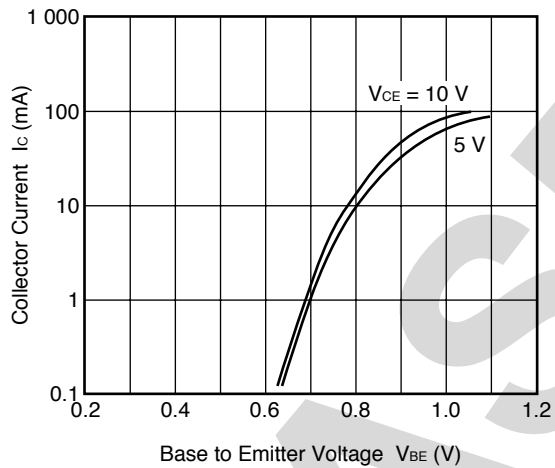
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



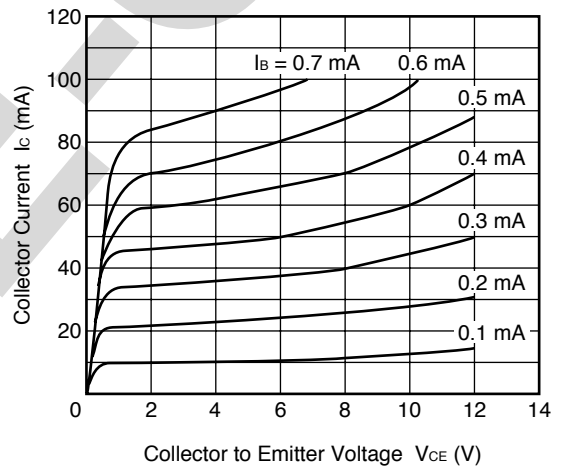
REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



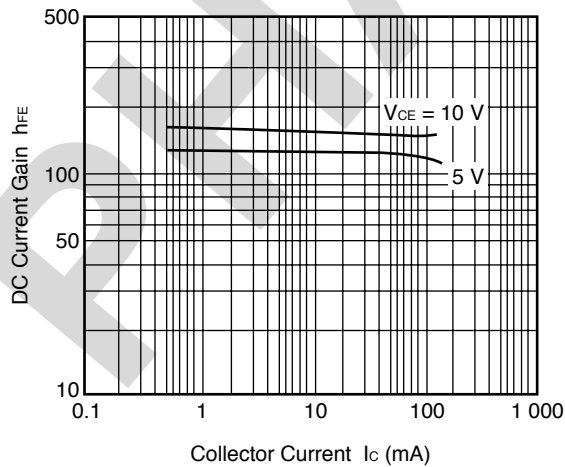
COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



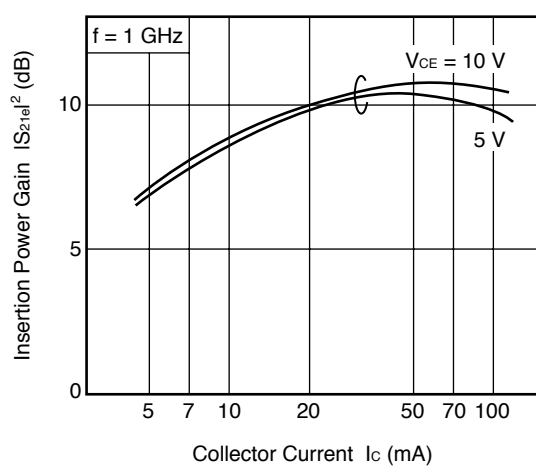
COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



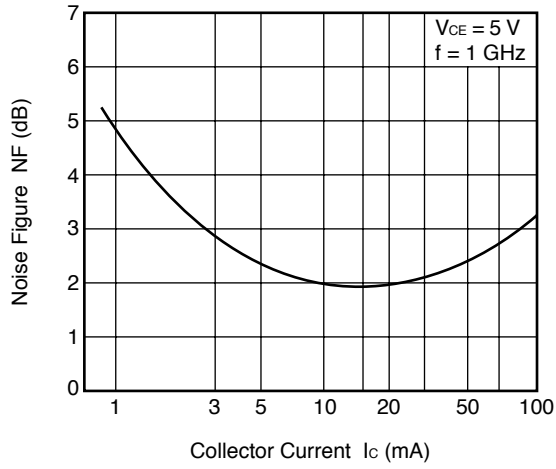
DC CURRENT GAIN vs. COLLECTOR CURRENT



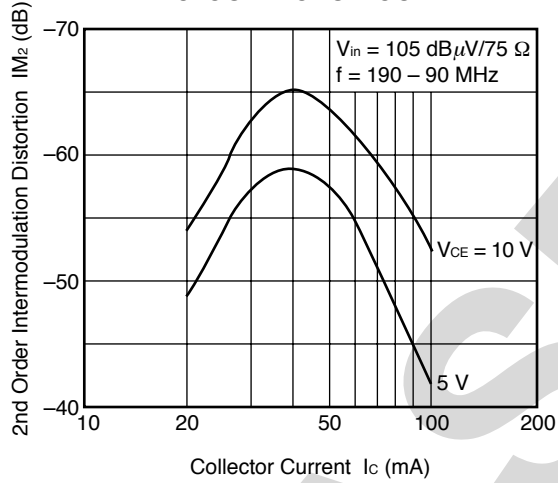
INSERTION POWER GAIN vs. COLLECTOR CURRENT



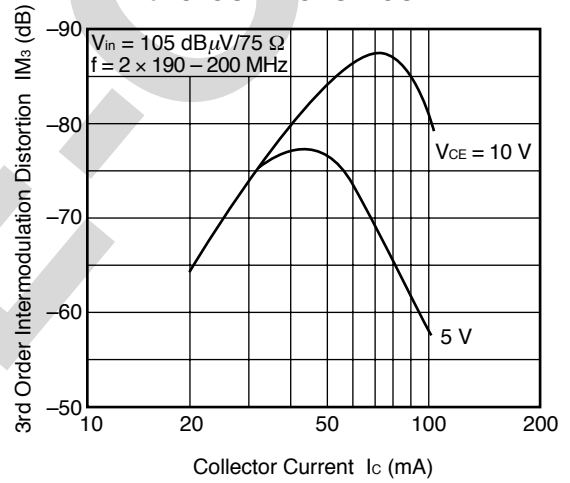
NOISE FIGURE vs. COLLECTOR CURRENT



IM<sub>2</sub> vs. COLLECTOR CURRENT



IM<sub>3</sub> vs. COLLECTOR CURRENT



**Remark** The graphs indicate nominal characteristics.

**S-PARAMETERS**

V<sub>CE</sub> = 5 V, I<sub>C</sub> = 50 mA

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.642	-61.5	19.689	138.5	0.026	64.9	0.603	-39.7
0.2	0.521	-103.0	13.393	116.8	0.045	53.1	0.461	-62.1
0.3	0.464	-123.8	9.708	106.3	0.053	57.8	0.359	-72.8
0.4	0.428	-137.2	7.480	99.5	0.059	62.1	0.304	-75.7
0.5	0.408	-147.7	6.078	94.5	0.072	63.7	0.289	-79.4
0.6	0.390	-154.3	5.104	91.3	0.080	65.9	0.275	-83.2
0.7	0.374	-161.1	4.394	88.6	0.088	66.2	0.277	-82.8
0.8	0.360	-163.9	3.880	86.2	0.097	68.9	0.261	-85.0
0.9	0.348	-168.0	3.527	84.5	0.110	72.1	0.271	-81.6
1.0	0.351	-175.1	3.224	83.3	0.119	72.0	0.268	-79.9
1.1	0.329	-179.9	3.111	81.8	0.125	76.4	0.276	-75.5
1.2	0.328	179.8	3.078	78.9	0.144	73.7	0.321	-75.3
1.3	0.319	171.9	2.914	69.6	0.157	77.8	0.320	-82.4
1.4	0.297	168.9	2.501	66.2	0.166	75.7	0.291	-83.6
1.5	0.307	165.2	2.285	65.3	0.182	77.7	0.325	-83.4
1.6	0.308	159.6	2.115	63.9	0.192	77.7	0.305	-82.7
1.7	0.303	156.6	1.993	62.9	0.201	77.4	0.313	-81.7
1.8	0.309	154.1	1.880	62.0	0.219	75.5	0.327	-83.5
1.9	0.312	150.3	1.786	60.8	0.222	74.9	0.321	-86.3
2.0	0.315	148.4	1.704	59.9	0.242	75.9	0.341	-91.2

V<sub>CE</sub> = 5 V, I<sub>C</sub> = 100 mA

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.647	-73.2	21.091	134.7	0.039	58.3	0.793	-45.3
0.2	0.529	-112.8	13.280	113.6	0.060	53.9	0.561	-71.0
0.3	0.480	-133.5	9.390	103.3	0.072	54.2	0.409	-82.3
0.4	0.459	-146.3	7.213	96.7	0.079	55.6	0.360	-86.1
0.5	0.443	-155.4	5.826	92.0	0.090	58.6	0.333	-90.2
0.6	0.424	-160.9	4.890	89.2	0.102	57.6	0.315	-95.6
0.7	0.406	-166.8	4.206	86.9	0.111	61.4	0.297	-96.0
0.8	0.401	-169.8	3.711	84.3	0.120	64.2	0.292	-95.6
0.9	0.396	-173.9	3.372	82.7	0.135	66.9	0.288	-93.9
1.0	0.391	-178.9	3.093	81.8	0.143	67.0	0.294	-91.3
1.1	0.361	176.3	2.950	80.4	0.157	67.4	0.298	-86.5
1.2	0.366	175.3	2.984	77.2	0.166	67.9	0.338	-86.4
1.3	0.363	167.7	2.788	67.5	0.178	68.5	0.359	-94.6
1.4	0.337	165.3	2.413	64.6	0.192	71.3	0.320	-95.5
1.5	0.352	160.9	2.194	63.4	0.210	70.8	0.322	-96.3
1.6	0.349	157.0	2.017	61.7	0.220	68.8	0.314	-92.3
1.7	0.352	154.7	1.900	60.9	0.236	69.4	0.329	-91.1
1.8	0.353	152.0	1.810	60.3	0.248	69.1	0.339	-93.7
1.9	0.354	147.9	1.730	58.8	0.252	68.8	0.336	-98.1
2.0	0.354	146.6	1.633	57.8	0.261	66.2	0.342	-98.2

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 50 mA

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.699	-59.3	21.061	140.1	0.037	68.2	0.860	-37.6
0.2	0.540	-97.0	14.088	118.4	0.057	57.8	0.629	-62.0
0.3	0.461	-119.1	10.216	107.1	0.066	55.0	0.464	-72.1
0.4	0.423	-133.2	7.898	99.9	0.076	56.4	0.409	-77.1
0.5	0.403	-144.4	6.431	95.0	0.087	56.6	0.375	-80.6
0.6	0.383	-150.8	5.407	91.8	0.099	58.7	0.363	-86.2
0.7	0.355	-158.1	4.640	89.3	0.110	59.6	0.327	-87.7
0.8	0.338	-161.3	4.093	86.7	0.118	61.4	0.323	-87.8
0.9	0.333	-165.1	3.723	84.9	0.129	63.9	0.310	-86.0
1.0	0.322	-172.7	3.406	84.0	0.137	66.0	0.324	-83.2
1.1	0.303	-177.8	3.245	82.6	0.150	65.6	0.333	-79.9
1.2	0.306	-178.3	3.278	79.5	0.159	66.2	0.371	-80.5
1.3	0.295	171.3	3.074	69.9	0.168	67.6	0.377	-86.5
1.4	0.276	171.0	2.644	67.0	0.180	69.7	0.347	-86.7
1.5	0.283	164.5	2.397	66.2	0.198	70.5	0.363	-88.4
1.6	0.282	159.5	2.208	64.7	0.208	69.1	0.342	-85.6
1.7	0.283	157.3	2.088	64.1	0.220	70.0	0.344	-86.0
1.8	0.287	154.8	1.986	62.6	0.232	70.0	0.366	-87.8
1.9	0.290	150.4	1.886	61.7	0.247	69.4	0.371	-89.3
2.0	0.300	148.7	1.787	60.7	0.254	68.4	0.361	-92.9

V<sub>CE</sub> = 10 V, I<sub>C</sub> = 100 mA

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)	MAG.	ANG. (deg.)
0.1	0.651	-64.8	21.694	136.2	0.029	62.4	0.588	-43.4
0.2	0.520	-106.4	14.288	114.6	0.042	53.0	0.435	-62.7
0.3	0.460	-126.5	10.214	104.5	0.051	56.6	0.330	-73.0
0.4	0.420	-140.1	7.822	98.1	0.061	58.4	0.284	-77.1
0.5	0.395	-150.0	6.355	93.2	0.070	65.6	0.270	-78.8
0.6	0.384	-156.3	5.314	90.3	0.077	67.0	0.257	-82.2
0.7	0.367	-162.9	4.569	87.8	0.089	70.9	0.258	-82.1
0.8	0.350	-165.5	4.037	85.6	0.095	71.6	0.241	-82.9
0.9	0.343	-169.3	3.649	83.8	0.106	72.5	0.257	-79.5
1.0	0.339	-177.1	3.353	82.8	0.117	73.9	0.258	-79.3
1.1	0.316	177.9	3.193	81.0	0.125	75.0	0.261	-73.6
1.2	0.315	179.4	3.217	78.4	0.142	75.5	0.311	-72.3
1.3	0.309	170.1	3.026	69.1	0.152	78.1	0.324	-80.4
1.4	0.287	165.6	2.592	65.9	0.164	75.6	0.280	-81.0
1.5	0.303	161.9	2.374	65.2	0.173	80.5	0.308	-82.6
1.6	0.293	157.9	2.179	63.5	0.187	78.1	0.295	-81.4
1.7	0.301	153.7	2.054	62.4	0.200	78.2	0.307	-78.7
1.8	0.303	150.7	1.945	61.4	0.214	75.9	0.313	-82.1
1.9	0.306	148.8	1.840	60.5	0.225	75.4	0.321	-82.8
2.0	0.311	147.2	1.753	59.7	0.240	75.0	0.332	-86.9



## NOTICE

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. California Eastern Laboratories and Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. California Eastern Laboratories has used reasonable care in preparing the information included in this document, but California Eastern Laboratories does not warrant that such information is error free. California Eastern Laboratories and Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. California Eastern Laboratories and Renesas Electronics do not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of California Eastern Laboratories or Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. California Eastern Laboratories and Renesas Electronics assume no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc. "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc. Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. California Eastern Laboratories and Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by California Eastern Laboratories or Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by California Eastern Laboratories, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. California Eastern Laboratories shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a California Eastern Laboratories sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. California Eastern Laboratories and Renesas Electronics assume no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of California Eastern Laboratories, who distributes, disposes of, or otherwise places the Renesas Electronics product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, California Eastern Laboratories and Renesas Electronics assume no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of California Eastern Laboratories.
12. Please contact a California Eastern Laboratories sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

**NOTE 1:** "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

**NOTE 2:** "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

**NOTE 3:** Products and product information are subject to change without notice.

**CEL Headquarters** • 4590 Patrick Henry Drive, Santa Clara, CA 95054 • Phone (408) 919-2500 • [www.cel.com](http://www.cel.com)

For a complete list of sales offices, representatives and distributors,  
Please visit our website: [www.cel.com/contactus](http://www.cel.com/contactus)